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THE TIME-RELATIONS OF MENTAL PHENOMENA.

THE study of the time-relations of mental phenomena is important from several points of view: it serves as an index of mental complexity, giving the sanction of objective demonstration to the results of subjective observation; it indicates a mode of analysis of the simpler mental acts, as well as the relation of these laboratory products to the processes of daily life; it demonstrates the close inter-relation of psychological with physiological facts, an analysis of the former being indispensable to the right comprehension of the latter; it suggests means of lightening and shortening mental operations, and thus offers a mode of improving educational methods; and it promises in various directions to deepen and widen our knowledge of those processes by the complication and elaboration of which our mental life is so wonderfully built up. It is only within very recent years that this department of research has been cultivated; and it is natural that the results of different workers, involving variations in method and design, should show points of difference. In spite of these it seems possible to present a systematic sketch of what has been done, with due reference to the ultimate goal as well as to the many gaps still to be filled. It is with the object of furnishing such a general view that the following exposition has been attempted.

Rate of Nervous Impulses.

While it follows, as a very natural consequence of the modern view of the relation between body and mind, that mental processes, however simple, should occupy time, it must be remembered that the very opposite opinion has been held by serious thinkers. It has been argued as a proof of the immateriality of thought that its operations were out of relation to time, and the expression "quick as thought" has come to indicate a maximum of speed. It being established that so comparatively simple a process as sensation involves the passage of an impulse along nerve-fibres, it is plain that the rate of travelling of this impulse sets a limit to the time of the entire process, as well as of all more complicated mental operations in which sensations are involved. The physiologist Johannes Müller, writing in 1844, despaired of our ever being able to measure the time of so excessively rapid and short a movement; but before the close of the same decade, Helmholtz measured the rate in the nerve of the frog, finding it to be about 86 feet per second. Though somewhat greater in man, 110 feet per second, this movement is extremely slow compared with the velocity of light or even sound: indeed, it is only slightly faster than the fastest express train.

Müller writes: "We shall probably never secure the means of ascertaining the speed of nerve activity, because we lack

the comparison of enormous distances from which the speed of a movement, in this respect analogous to light, could be calculated;" and again: "The time in which a sensation proceeds from the periphery to the brain and the spinal cord, and is followed by a re-action at the periphery by means of muscular contractions, is infinitely small and immeasurable." It is interesting to note how very crude were the conceptions of the older physiologists upon this point. Haller (1762) tells us of one who, following the view that the nervous impulse was a fluid, and its action analogous to that of the blood, found the "nerve tubes" of the heart to be 2,880 million times as narrow as the aorta, and concluded that the nervous impulse travelled proportionately faster than the blood, thus making its rate 57,600 million feet per second. Haller himself measured the maximum rapidity of short rhythmical movements, and (falsely), assuming that the impulse travelled to and from muscle and brain between each contraction, found an (accidentally not very erroneous) speed of 9,000 feet per second. The method introduced by Helmholtz, and improved by himself and others, consists in excising a muscle with a long stretch of nerve attached, and connecting the muscle with a lever, so that every contraction of it is registered upon the quickly moving surface of a revolving drum or a swinging pendulum. By electrically stimulating the nerve first at a point near to and then at a point far off from the muscle, two curves are recorded, the latter of which is found to leave the base line a trifle after the former. A tuning-fork writes its vibrations beneath these records, and enables us to measure how much later the second contraction began, while the distance travelled in this time is that between the two points of stimulation on the nerve. It has been attempted to measure this rate in man by having the subject re-act once to a stimulus applied to the foot, and again to a stimulus at the hip, or some point nearer the spinal cord, and counting the difference in time as due to the difference in length of nerve traversed. While the method is necessarily inaccurate, and other factors contribute to the difference in time, the majority of the determinations indicate a rate of between 30 and 40 metres (100 to 130 feet) per second. These determinations apply to sensory nerves: for the motor nerves of man, Helmholtz has found, by a method closely similar to that employed upon the frog, a rate of 110 feet per second. The most influential of the conditions affecting this rate is temperature: cold decreases and heat increases it, the extremes of variation being 30 to 90 metres. Under normal conditions it seems fair to regard the rate for both motor and sensory nerves of man as about 110 feet per second.

Analysis of Re-actions.

A great variety of actions may be viewed as responses to stimuli. There is a flash of light, and we wink; a burning cinder falls upon the hand, and we draw it away; a bell rings, and the engineer starts his train, or the servant opens the door, or we go down to dinner; the clock strikes, and we stop work, or go to meet an appointment. Again, in such an occupation as copying, every letter or word seen acts as a stimulus, to which the written letter or word is the

response; in piano playing, and the guidance of complicated machinery, we see more elaborate instances of similar processes. The printer distributing "pi," the post-office clerk sorting the mails, are illustrations of quick forms of re-action, in which the different letters of the alphabet or the different addresses of the mail matter act as the stimuli, and the placing them in their appropriate places follows as the response. In many games, such as tennis or cricket, the various ways in which the ball is seen to come to the striker are the stimuli, for each variation of which there is a precise and complex form of response in the mode of returning the ball. In military drill the various words of command are the stimuli, and the actions thus induced the responses; and such illustrations could be multiplied indefinitely. In all these actions the time-relations are more or less definite and important, but a useful study of them presupposes a careful and systematic analysis of the processes therein involved. We recognize that certain of the above actions are more complicated than others, and we must inquire in what this complication consists. In the process as usually presented the nature of the re-action depends upon the nature of the stimulus, a variation in the one being concomitant with a variation in the other. The piano player, seeing a certain mark on the page, strikes a certain key on the key-board, but strikes a different key if this mark be differently placed; the soldier varies his movement according to the word of command, and so on with most of the others. All such actions involve at least three processes: (1) the recognition of the sense impression, (2) the performance of the appropriate action, and (3) the association of the one with the other. The recognition involves the appreciation of the *presence* together with the appreciation of the *nature* of the sense-impression; and the movement involves the contraction of muscles together with the initiation of the impulse. We obtain the simplest form of re-action by limiting the stimulus to a single definite one, and having one and the same response irrespective of the nature of the stimulus. The subject expects the stimulus the nature of which he knows, and is ready to signal, by a simple movement agreed upon in advance, *merely* that the impression has been received. This we shall speak of as a "simple re-action." It occurs whenever a certain sense-impression is agreed upon as a signal for the execution of a simple movement. The time-keeper pressing the spring of the stop-watch, or the racer starting off as soon as the pistol is fired or the word is given, are instances of simple re-actions. It should be noted that the simplicity of the act refers primarily to the subject's fore-knowledge of what is to occur; the nature of the sense-impression, as of the motion, is known in advance, the association between the two being in the main artificial. Inasmuch as the more elaborate mental processes involve those of the simple re-action, our first step must be to determine its elements and their time-relations.

The Elements of a Simple Re-action.

The several elements of a simple re-action have been variously analyzed by different observers, but all recognize the *physiological* and the specially *psychological* portions of the process. The physiological time-elements include, (a) the time for the sense-organ to respond to an impression, i.e., to overcome its inertia; (b) the time for the passage of

the impulse inward along nerves (and spinal cord), with the various delays whenever the impulse enters or passes through cells; (c) the return passage of the motor impulse from the brain to (spinal chord and) nerve and muscle; and (d) the time for the contraction of the muscle. The time thus left unaccounted for is that taken up by the psychological process, the transformation of the sensory into the motor impulse,—a process taking place in the brain, but as to the precise nature of which we have no definite information. The separate determination of each of the physiological factors enables us to find approximately the duration of the central process. As a sufficiently typical case we may accept the estimate of Cattell, that, in re-acting to a light by pressing the key with the finger, the time needed by the impulse to travel from eye to brain and from brain to spinal cord and finger is about 50σ ; the latent time in the muscle, during which it overcomes its inertia, is judged from experiments upon the frog to be about 5σ to 10σ ; and experiment gives a value of 15σ to 20σ for stimulating the retina and initiating the impulse. As the entire re-action occupied about 150σ we conclude that in this case the physiological and the psychological portions of the process occupy about equal times. One may obtain a fair notion of the rate of these processes by the following simple experiment. A score or so of persons form a chain by joining hands, and at a given signal a certain member of the group sharply presses the hand of his neighbor, who in turn imparts the pressure as quickly as possible to *his* neighbor, and so on until the impression has gone the rounds. An outsider keeps the time (which may be done with sufficient accuracy by counting the ticks of a watch, usually fifths of a second) from the moment of giving the signal to start to the moment of receiving the signal from the last member of the group that the impression has been circulated. The entire time divided by the number of persons in the group (or better, by that number plus two to include the re-actions at starting and stopping) gives an average simple re-action-time, which, though long at first, is reduced after a little practice to a sixth or a seventh of a second. On this basis one may calculate that if a number of men, stretching out their arms and grasping one another's hands, were stationed in a straight line, it would take three minutes to send a message in the manner just described along a mile of this human telegraph.

(a) The inertia of sense-organs has been variously determined. One method measures how closely impressions may follow one another without fusing. The time thus measured is the minimum time during which the sense-organ may be stimulated and recover sufficiently to receive a second stimulation. This process thus includes something more than the one we desire to measure, and may perhaps be regarded as furnishing a maximum time of the sensory inertia. Here again various circumstances influence the determinations, the chief ones being the sense-organ in question and the clearness and intensity of the impression. Sectors of black and white upon a disc revolving in daylight at the rate of about 25 times a second fuse into a uniform gray, making the inertia of the retina under these conditions about 40σ . In weak light (moonlight) the time lengthens to about 100σ . The same experiment has been made with sectors of different colors, with the disc stationary and the light reflected from a rotating mirror, with a vibrating point of light; and, while all these variations somewhat affect the result, the majority of the determinations indicate a fusion at 30 to 40 impressions

¹ The sign σ indicates one one-thousandth of a second.

a second, or a duration of 33σ to 25σ . For sound, different observers have chosen different points for measurement. The slowest rate of impressions fusing into a musical sound has been fixed at between 30 and 40 per second; but Helmholtz has shown that the interference of sound-waves perceptible as beats does not escape detection when recurring as rapidly as 132 per second. For non-musical sounds, such as electric clicks, a still higher rate has been found. In touch we distinguish differences of feeling when impressions are rapid enough to fuse but not rapid enough to fuse perfectly. The smoothness of a polished surface is not obtained until the impressions occur 480 to 640 times a second (Valentin). For taste and smell the period, though not accurately determined, is undoubtedly very long. Here the time needed to reach the somewhat concealed sense-organs is considerable, and the chemical processes involved are relatively slow in action. The influence of the mode of activity of the sense-organ upon its period of stimulation is further illustrated in the long inertia period of the probably chemical action of vision compared with the short period of the mechanical senses of hearing and touch. This view is also supported by the fact that the period for the retina is shortened if the eye be directly stimulated electrically. Another mode of experimenting consists in applying a stimulus for the minimum time during which it can be recognized. The time thus measured will be shorter than the other, for it tells us only how long is needed for initiating the process of recognition sufficiently to have it continue to completion (probably after the stimulus ceases). This is indeed a surprisingly short time. Cattell and Sanford independently found that a color or a letter could be recognized when visible for only from 1σ to 5σ , while recently Baxt recognized 6 to 7 letters when exposed for only 5σ . Others have calculated that the maximum effect of an impression is not reached until from 50σ to 150σ , but these determinations seem to involve some mental process of recognition. Whether or not some such process of recognition is involved is not quite clear. Unless specially prevented, the recognition will take place on the basis of the after-image, a few thousandths of a second being sufficient to initiate the process. By following the impression by a strong flash of light, and thus nullifying the after-image, Baxt found a longer time needed to recognize a more complicated impression. Within 10σ to 15σ , one letter; within 24σ , three letters; within 34σ , four letters, could be recognized. This only partially excludes the effect of the after-image, so that perhaps the results with complicated impressions are minimum "recognition times," and those with simple impressions "inertia times." Another method, that of Exner, is similar to the method of fusion. It consists in finding how closely two impressions, stimulating slightly different portions of the sense-organ, may follow one another and yet be recognized as successive. Optical impressions were so recognized when falling at an interval of 44σ on two points of the retina near the centre .011 millimetres apart, a longer time being necessary if the points are away from the centre of the retina. It seems probable that this process is more complicated than the one we are attempting to study. While the data thus at our disposal do not allow us to fix accurately the time of sensory inertia, the estimate provisionally accepted in the text cannot be far from the truth, being rather over than under estimated. The methods of measuring the rate of nervous impulses (*b*) and (*c*) have already been described. The inertia of the muscle and the time of its contraction are determined upon the same apparatus by observing how much after the shock is given the curve leaves the base-line.

Reflex, Automatic, and Voluntary Re-actions.

The term "re-action" as here used is not intended to include all responses to stimuli. The above instanced forms of re-actions present various grades of naturalness, utility, and habituation; that is, the association between motion and stimulus has by practice become more or less close and easy. Copying, for example, may become so entirely automatic

that it runs on of itself without the need of renewed volitional effort. The actions recognized as reflex take place in spite of all volition. The re-actions here considered are limited to those requiring some degree of voluntary effort for their execution, though this may be almost indefinitely reduced by practice. The reflex act takes very much less time for its execution than the voluntary: the time for winking has been determined by Exner to be something over 50σ . In other words, it takes about three times as long to signal by a voluntary closure of the eye-lid that an impression has been received as to perform the same act reflexly when the eye is threatened. The utility of this quick action for the protection of the eye is evident; and other useful re-actions, such as those of flight and escape in timid animals, seem to be of a similar nature. The quick movements of defence when attacked; of regaining one's balance when slipping, are so immediately useful and so well inculcated in the organism as often to surprise us by their quickness. Most of these actions can also be performed voluntarily, but neither so well nor so quickly; it is therefore difficult to subject them to experiment. As already indicated, in the ordinary re-action there is little naturalness in the connection of stimulus and movement, the same type of movement being used for all. The experienced re-actor becomes accustomed to signal by the finger movement that the operation required of him has been accomplished, but hardly associates this movement with any particular stimulus.

It is perhaps well to add that the great saving of time in actions that have become automatic (such as is seen in the experienced piano player or post-office clerk as compared with the beginner), is in great part due to the increased facility of doing several things at once and not serially, a factor that enters only in a small degree into the simple re-action. The processes we should be most interested in measuring are those most closely approaching the operations of daily thought, so that the inference from experiment to practice shall be as direct as possible. This, however, it is difficult to do, because every-day mental processes do not present the simplicity of conditions required by experiment. Accordingly the method has been to study the simplest re-actions, and then take into account the circumstances in which our usual mental operations differ from them.

[To be continued.] JOSEPH JASTROW.

LEGISLATION ON FOOD ADULTERATION.

THE adulteration of alimentary substances has been practised from the most ancient times, and numerous laws and regulations have been adopted in various countries to check and prohibit such sophistications.¹

France has taken the lead in protecting consumers of food from adulterations, and in 1802 the Conseil de Salubrité was established in Paris. In England as well as in France, Germany, and other Continental countries, laws against the adulteration of individual articles, such as tea, coffee, beer, and wine have been passed since the middle ages. The first general act was not passed in England till 1860, and this was amended in 1872. However, they were found unsatisfactory, and the Sale of Food and Drugs Act was passed in 1875, and further amended in 1879 in the endeavor to obtain

¹ For copies of European laws on food adulteration see Report of the Commissioner of Internal Revenue for 1888 and for 1889; and for a summary of their leading features see Science, xiv., p. 308.

a workable law. This latter law is now in force, though the third and fourth sections of the act, relating to the mixing, coloring, staining, or powdering of any article of food so as to injure health, or in the case of drugs so as to injure their quality, are practically of no value and unenforced, because the fifth section provides that guilty knowledge is essential to the proof of the offence, and no prosecution, unless supported by very exceptional circumstances, would be successful under these sections. Sections 6 to 9 are the ones that are found workable, and provide that no person shall sell foods or drugs, with certain exceptions, to the prejudice of the purchaser; shall not abstract any constituents of food, and that compound foods or drugs must be in accordance with the demands of purchase, though with these sections again a large loop-hole for the escape of offenders is provided in section 8, which states that a legible descriptive notice that the article sold is a mixture exonerates the seller.

The amendment act passed in 1879 defined the meaning and effect of section 6, under which conflicting decisions had been given in England and Scotland. In fact, in the latter country the act had been inoperative since the decision by a majority of the judges of the High Court of Justiciary in Scotland that an official purchaser under section 13 of the act, buying samples for analysis and not for consumption, or at his own expense, could not be prejudiced by the purchase, and consequently that no offence would be committed under section 6. The court also held that the words "nature, substance, and quality," in section 6, could not be disjointed, and the article sold must be different in all three respects from the article demanded, and that as the statute was intended to strike only at foreign admixtures, the very nature of the substance must be altered, or the offence contemplated could not be committed (*Davidson v. McLeod*, Cowper's Reports, Vol. III., p. 538).

In the United States, on June 26, 1848, an act was passed by Congress to secure the purity of imported drugs, and is still in force. Its efficacy is directed principally towards Peruvian bark and opium.

The tea adulteration law was passed by Congress March 2, 1883, and on Aug. 2, 1886, the oleomargarine law was passed, defining butter and butter substitutes.

A law "to prevent the manufacture or sale of adulterated food or drugs in the District of Columbia," was passed by Congress in October, 1888. This law is modelled on the Sale of Food and Drugs Act, 1875, of Great Britain, sections 2, 3, 4, 5, 6, 7, 8, 9, 12, 17, 24, 25, and 27 (see Annual Report Commissioner Internal Revenue, 1888, p. cxcv), with certain necessary provisions of the English act omitted, especially those in regard to its mode of enforcement, the collection, identification, and payment for analysis of samples, etc. The law does not provide that the Commissioner of Internal Revenue shall enforce its provisions in procuring samples of food or drugs, that matter being delegated to "any purchaser," "any health officer, inspector of nuisances, or any food inspector," only requiring that the analysis shall be under his control "under such rules and regulations as may be prescribed by the Secretary of the Treasury." The officers specified in the act are not under the control of the Commissioner of Internal Revenue nor of the Secretary of the Treasury.

Our different State laws on the subject are most of them

drawn up in a "follow-the-leader" style, under the popular but erroneous impression that any substance used as an adulterant of or a substitute for a food product is necessarily injurious to health, with the consequence that these laws are, with very few exceptions, merely dead letters.¹ In 1877 several of the State boards of health united, viz., those of New York, New Jersey, Massachusetts, and Michigan, and at their instance laws formulated on the English law were passed, and annual reports are now made by these boards on the results of the examinations of their chemists on the adulterations of foods and drugs practised in their several States. In the former State the law has proved a failure, because in an action brought to obtain "an injunction against the sale of certain Ping Suey teas it was held by the court, in refusing to grant the same, that, although the teas in question had been clearly shown to be adulterated with gypsum, Prussian blue, sand, etc., it was likewise necessary to prove that the effect of these admixtures was such as to constitute a serious danger to public health,"² In Massachusetts, however, the law has been enforced with vigor by the State Board of Health, and the yearly reports show a diminution in the percentage of adulteration of the samples submitted to analysis.

Owing to these faulty definitions and inadequate means of enforcement our State laws are inoperative, and until we have a national law to regulate the sale of adulterated articles of food, whereby the co-operation of State and national authorities could be secured in the enforcement of its provisions in regard to this class of fraud, the food sophisticater will pursue the even tenor of his way undisturbed. A national law would not apply to adulterated articles of food manufactured and sold in the State or Territory where produced, unless it should take the form of a revenue measure, imposing a tax upon the manufacturers of and dealers in such commodities.

On turning to some of the European Continental legislation on this subject we find that every dealer is held responsible for the quality of his merchandise, whether of foreign or domestic origin, and every food material must be sold under its true name; artificial products imitating a natural product must be properly labelled in a conspicuous and legible manner; all unwholesome foods are confiscated and destroyed without compensation to the owner; and adulterations generally are considered acts of fraud. Suitable police supervision and control are provided for the enforcement of these statutes; and, although these laws are somewhat of a paternal nature, they are much more effective than any we have.

The average American repudiates the idea of a paternal government supervision over his affairs, or any thing tainted with the idea. He may be willing to support, even to clamor for, a legislative measure to regulate the production or sale of a food product, provided it advances his particular business interests. He would, however, regard with apathy any general law that would guarantee to the public the liberty of purchasing pure food, with a reasonable certainty that they were not imposed upon in their purchases, if it was incumbent on him to take the necessary steps to execute its provisions by bringing samples for analysis, etc.

¹ For list of State laws on food adulteration see Report of the Commissioner of Internal Revenue, 1888, p. cxi.

² Battershall, Food Adulteration and its Detection, p. 8 (New York, 1887).

Let us consider what should be some of the leading provisions and definitions of such a proposed national law.

Definitions.

The word "food" should be defined as including every eatable, beverage, commodity, material or ingredient for food whatsoever, intended for consumption; and an article of food shall be deemed to be "adulterated"—

(1) If any substance has been added thereto which does not exist in the normal article or is only found there in an appreciably lower proportion;

(2) If any substance has been subtracted therefrom which is normally present in the article and which is not found in the abnormal article, or only there found in an appreciably lower proportion;

(3) If any substance has been substituted wholly or in part for the article;

(4) If it be an imitation, or sold under the name of another article; and

(5) If it consists wholly or in part, whether manufactured or not, of an animal or vegetable substance that is diseased, decomposed, putrid, or rotten: provided, that the addition to foods of any substance that increases their value; or the subtraction from foods of any inferior constituent, without deteriorating the resulting article; or the substitution of a superior for an inferior article, where there is no intention to defraud or to deceive, shall not be considered adulterations within the meaning of the act.

When substances known to be injurious to health (as

in most foreign countries having laws on the subject: salicylic acid and its salts, boracic acid and borax, glycerine, alum, beta-naphthol.

The following is a list of harmless coloring matters: Black,—Chinese black. Blues,—Berlin blue, indigo, litmus, Prussian blue, saffron blue, ultramarine. Brown,—caramel. Greens,—chlorophyl, as spinach juice, mixtures of yellow colors with blue. A mixture of Prussian blue, Berlin blue, and Persian berries gives a green rivalling in brilliancy Schweinfurt's green. Reds,—annatto, Brazil lac, carmine, carmine lac, cochineal, orseil, the juice of beets and red berries, such as cherries and currants, etc. Yellows,—Avignon berries, curcuma, fustel, marigold, Persian berries, quercitron, safflower, saffron, turmeric. Chalk, and the ochres.

The adulteration of food, as specified in the first four definitions, being aimed at the pocket and not at the health of the consumer, the taxes, fines, or penalties, as the case may be, provided for their violation should be such as to make dealing in them, unless clearly and distinctly labelled and branded, unprofitable. By thus compelling all manufacturers and dealers to wrap, label, and brand in a conspicuous manner all articles of food intended for consumption adulterated within the meaning of the first four definitions, the purchaser could readily recognize that such articles were of an inferior quality, and therefore should not be as expensive as the pure article. For instance, a mixture of beef stearine and cotton-seed oil has been placed on the market to compete with lard having been sold as "refined or compound lard"

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(3) If any substance has been substituted wholly or in part for the article;

(4) If it be an imitation, or sold under the name of another article; and

(5) If it consists wholly or in part, whether manufactured or not, of an animal or vegetable substance that is diseased, decomposed, putrid, or rotten: provided, that the addition to foods of any substance that increases their value; or the

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However perfect the definitions or severe the penalties for violations of the law may be, still, unless the means for enforcing its provisions are furnished, no good would come of it. The establishing and maintaining the force necessary for the due supervision and control, under a national law, of such adulterated foods should be suitably provided for, and the rules and regulations for their guidance should be vested in some responsible bureau officer, with the approval of the Secretary of the Department.

This force should be divided into two classes: (1) The inspectors, who would be assigned to certain districts, and should visit all manufactories of food products, including slaughter-houses and dairies, and the places of all dealers where articles of food intended for consumption are sold, displayed, or stored, procuring, by purchase or otherwise, samples for inspection or analysis. They should have the necessary police authority to detain, seize, or destroy adulterated articles of food wherever found, as now vested in most municipal sanitary police officers. (2) The analysts, under the control of a chief, would be required to make the necessary chemical and physical examinations of the samples of food collected by the inspectors, or submitted, under suitable regulations, by other parties. The duly verified certificate of an analyst, stating that the examination of the sample submitted shows it to be adulterated within the meaning of the act, shall be received as evidence of the fact in any proceedings taken against any person for violation of the law. The defendant, however, shall have the right to require the attendance of the analyst for the purpose of cross-examination.

Standards of strength, quality, or purity of different foods shall be fixed from time to time and prescribed by the Secretary of the Department for the guidance of the analysts.

Where samples of food products are received from the public at large they should be accompanied with an affidavit stating the facts in the case, and a small fee for the analysis of the same should be paid in advance.

The inspection of meat, fish, vegetables, fruit, and especially milk, should be done daily in any large city, and properly belongs to the health department of such city.

If such a law should take the form of a revenue measure many provisions of existing laws in regard to special taxes, stamps, brands, returns, notices, etc., could be made to apply, and very little increase in the force of the Internal Revenue Bureau would be needed.

If the manufacturers of adulterated goods paid special taxes at the rate of one dollar per month, wholesale dealers fifty cents per month, and retail dealers twenty cents for the same time, and a tax of one mill per pound were collected on every article of food adulterated within the meaning of the act, the revenue thus derived would not much more than cover the expense of enforcing such a law.

EDGAR RICHARDS.

NOTES AND NEWS.

AN ingenious contrivance has been recently adopted at the Hippodrome in Paris, with a view to producing scenic effects in the central oval space, without the spectators opposite being seen at the same time. *Nature* describes the contrivance as an elliptical screen of fine steel netting, which is let down in comparative darkness, so as to be about twelve feet in front of the benches. This is painted on the inner side with a representation of the Place du Vieux Marché at Rouen (the piece being "Jeanne d'Arc"), and,

as it is strongly illuminated, at a given moment, from the centre, the light outside being low, a spectator at any point has an excellent view of the scene, while seeing nothing of the crowd beyond.

—James W. Queen, who founded the well-known house of James W. Queen & Co. of Philadelphia, died on July 12. He had been retired from business many years, so that his death will have no effect on the Philadelphia firm.

—In his recent thesis on the influence of the sea-shore on leaves M. Pierre Lesage shows by conclusive evidence, says *Nature*, that a marine habitat leads to a thickening of the leaves. The palisade-cells are more numerous and larger than in the leaves of the same plants grown inland. Apparently the sea-salt is the cause of this alteration, as plants cultivated in artificially salted soil yield thicker leaves. The observations of M. Lesage bear on some ninety species of plants which are in their natural state found near the sea (in Brittany) as well as inland.

—Professor Thomas F. Hunt, Assistant Agriculturist of the Illinois Experiment Station, reports a comparative feeding test between corn fodder and corn silage, the results of which are slightly in favor of the dry cured fodder. While the results of the experiments are somewhat contradictory, those which bear evidence of the greatest thoroughness agree in indicating that there is practically no difference between the feeding values of a given quantity of corn cured as ensilage and an equivalent quantity cured as dry fodder, provided equally good husbandry has been practised in both cases. Whether corn may be cured and preserved more economically by the one process or the other depends largely upon local circumstances and seasonal peculiarities.

—Commenting on an article on the influence of the moon on weather, by Dr. G. Meyer, *Nature* says, that, although such investigations have hitherto given a negative result, the author thought that with the materials furnished by synoptic charts he might eliminate local influences, and he gives tables extending over a number of years, which seem to show the influence of the moon in lowering the height of the barometer in the months of September to January, at the time of full moon, and in raising it during the first quarter. The Deutsche Seewarte, which communicates the article, points out that a similar result has been independently arrived at by Captain Seemann, one of the assistants of the institution. The same effect or any other is not perceptible in other months.

—The following facts, quoted by *Nature* from its French namesake *La Nature*, relate to exceptional seasons in past centuries. They were collected by M. Villard, of Valence, for France especially, and for Europe generally. In 1282 the winter was so mild that corn-flowers were sold in Paris in February. New wine was also drunk at Liège on Aug. 24. In 1408 the winter was so severe that nearly all the Paris bridges were carried away by the ice. Ink froze in the pen, although a fire was in the room. [A similar fact is quoted by Dove as occurring at Sebastopol on Dec. 13, 1855.] All the sea between Norway and Denmark was frozen. The summers of 1473 and 1474 were disastrously hot. In the winter of 1544-45 wine was frozen in barrels all over France. It was cut with hatchets and sold by the pound. In 1572-73 nearly all the rivers were frozen. The Rhone was traversed by carriages at various places. In 1585 the winter was very mild; corn was in ear at Easter, but the third week in May was extremely cold.

—The Belgian Legation at Mexico has recently reported to the Belgian Government on the subject of "guimbobo," known also as "angu," which is found in the State of Vera Cruz, a plant which should be included in the category of all the varieties of Mexican textiles. An American specialist has been appointed to examine and report upon the fibre-producing qualities of this plant. This gentleman has discovered that the guimbobo produces not only a fibre of very superior quality, but that it can be easily and cheaply cultivated; moreover, the fruit of the plant constitutes a nutritious food. According to the *Journal of the Society of Arts*, it appears from experiments that have already been made that the guimbobo differs essentially from the ramie, cotton, and hemp, as in the guimbobo the covering of the plant surrounds the fibre, and is not mixed up and interlaced with it;

this constitutes a decided economy, added to great facility, in extraction and utilization. The structure of the plant permits of the operations of separating and removing the bark being performed by machinery, while in the other fibrous plants these operations must be effected by hand, a system at the same time very costly, and only possible in countries where there is a large number of hands available and cheap. It is stated by the American specialist that he could construct a machine, costing no more than the ordinary machines used for cotton, and which could be used in the same manner. By this machine the fibre could be extracted and sold by the pound in the same way as cotton. Persons cultivating this plant would benefit in addition by the sale of the fruit, which is much esteemed in the temperate and tropical countries of the South, where the guimbobo grows luxuriantly, and almost without any care. The fibre of the guimbobo has a lustre similar to that of silk, and is undoubtedly finer and stronger, with a creamy color between white and straw color.

—A new gun, the invention of M. Giffard, the well-known French inventor, is attracting considerable attention among military men in Europe. As described in the *London Times*, the propulsive agent in this novel weapon is carbonic acid gas, compressed to a liquid condition, and capable of giving a pressure of five hundred pounds per square inch. The liquefied gas is contained in a metallic tubular reservoir about nine inches long, which is fixed under and in a line with the barrel of the gun, and which is conveniently grasped by the left hand in firing. Although containing an immense store of power, there does not appear to be any danger in a weapon thus equipped. In the first place, the reservoir is made of Siemens-Martin steel of the highest quality, so that a burst is considered hardly possible; and, in the second, should a flaw in the metal lead to a fracture, the gas would simply escape much in the same way that it does on the opening of a bottle of soda water. Then, the quality of the metal used for the gas receiver is such that it will stand rough usage without liability to fracture. It may be, and, indeed, has been, knocked greatly out of shape when full of gas without any prejudicial result arising, the gas having been afterwards used for discharging projectiles from the gun. The bullet is dropped into a small aperture at the rear end of the barrel, and by moving a small lever it is deposited in the breech chamber of the gun. The hammer is then placed at full cock and the trigger pulled. By the fall of the hammer a pin is struck which opens a valve at the rear of the liquefied gas reservoir, and permits the instantaneous escape of a sufficient volume of gas for one discharge. The bullet is thus ejected with a force proportionate to the impelling power of the charge, which can be increased or decreased at pleasure by a simple screw arrangement. In other words, the propelling power is completely under control, although, of course, this in practice is not left to the arbitrary will of the ordinary user, but will be fixed and definite, according to the character of the gun in which it is employed. The discharge of the gun is unaccompanied by any report, nor is there the least recoil or kick. On pulling the trigger there is a slight hiss or puff, followed by the noise of the impact of the bullet upon the iron target. The reservoir is very light, and when charged with liquefied carbonic acid gas, is capable, according to the size and calibre of the gun, of discharging from one hundred to five hundred consecutive shots at a stated cost of less than one penny. It is stated that there is no fear of any part of the gun or its mechanism becoming oxidized by the gas, and it is hardly necessary to add that there is neither smoke nor smell from the propellant. There is also no deterioration of the liquefied gas from storage or keeping. With regard to the rifle itself, with the exception of the tubular reservoir carried under the barrel, there is no material difference in appearance between the Giffard gun and an ordinary weapon of similar character.

—The success which has attended the use of arsenical sprays in combating the curculio upon the cherry and plum has led to its trial upon peach trees. London purple appears to have been most generally used in these trials, because this material has been strongly recommended during the last few years as preferable to Paris green. The advantages which London purple possesses over Paris green are its cheapness, and the fineness and lightness of the

material, allowing it to remain longer in suspension in water. But the use of London purple upon the peach has often resulted in great injury to the foliage, and sometimes to the young shoots. The injuries in the Michigan peach orchards last year led Professor Cook, of the Michigan Agricultural Experiment Station, to experiment upon the influence of the arsenites upon foliage. He found that peach foliage is especially susceptible to injury, that London purple is more injurious to foliage than is Paris green, and that this is doubtless owing to the soluble arsenic which is quite abundant in London purple and almost absent in Paris green. The colored liquid left after the complete settling of the London purple was destructive to peach foliage. It appeared that greater injury occurred when the spraying was performed shortly before a rain, and that spraying soon after the foliage puts out is less harmful than when it is delayed a few days, or a few weeks. As a general result of the trials upon the peach, it was concluded that Paris green alone should be used, and that not stronger than one pound to three hundred gallons of water. Experiments in the same direction were performed at the Agricultural Experiment Station at Cornell University last year and this year, and the experiences of the two seasons coincide, so far as the experiments are comparable. The trials at Cornell, as given in the July Bulletin, show that peach foliage is very susceptible to arsenical poisons, and that London purple is much more injurious than Paris green. The young leaves are much less liable to injury than the full grown leaves. This is supposed to be due entirely to the waxy covering which is so abundant upon recent leaves and shoots. Late in the season, when the young and waxy growth is slight, nearly all the leaves will be killed by a mixture which would have had scarcely any effect when the tree is just pushing into growth in spring. Injury early in the season is less apparent, also, for the reason that growth of new leaves is so rapid that defoliation is obscured. In fact, the casual observer would not have noticed that the trees which shed their leaves in the earlier experiments had sustained the slightest injury, new leaves forming faster than injured leaves fell. Injury upon the leaf is first apparent in small and definite reddish-brown spots, which are visible upon both surfaces. The centre of the spot soon assumes a lighter color, and the tissue becomes dead and translucent. The edges of the leaf become discolored in like manner, and show a tendency to curl. A close observation discloses the fact that the discolorations take just the shape of the drops or streaks of liquid which lay upon the leaf. These leaves are at once distinguished from any which may suffer from fungous troubles by the absence of raised, puffed, or ragged borders about the spots, and by the presence of the scorched margins. Shoots are injured in the same manner as the leaves. Small bright red spots appear, and blotches mark the course of the liquid as it collected and ran down the stems. The whole shoot soon becomes abnormally red, as if its growth were arrested. Sometimes these shoots die outright, but they oftener survive. When the spraying is very copious, so that the liquid washes the foliage, half or more of the leaf may die outright without becoming much spotted. In such cases the injury is quickly apparent. The liquid runs down the stems freely, and they may suffer sooner than the leaves. In some of the trials, the death of the shoots caused the wilting of the foliage, and the leaves hung loosely for some days. Microscopic examination shows that the cell walls in the dead spots retain their shape, but the protoplasm is dry and shrivelled. The peach leaf has a very delicate structure, the epidermis being remarkably narrow, with thin-walled cells. This delicacy of structure appears to account for the peculiar susceptibility of the peach leaf to injury: the poison quickly permeates the tissue. Leaves injured by London purple were found, upon analysis, after thorough washing, to contain arsenic in the texture of the leaf, while analyses of leaves injured by Paris green showed no arsenic in the texture of the leaf. The poison in the latter case had acted from the surface of the leaf. It is apparent that London purple is the more injurious because of its soluble arsenic. The arsenic in London purple is in the form of a normal arsenite of calcium, which substance comprises about 72 per cent of the whole compound, and over 50 per cent of it, or nearly 40 per cent of the London purple, is quickly soluble in water.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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ORIGIN AND CHARACTER OF THE SAHARA.

At the annual meeting of the Scottish Meteorological Society on July 12, Dr. John Murray read an interesting paper, a summary of which is given in the August Proceedings of the Royal Geographical Society. In his paper, Dr. Murray treated of the meteorological conditions of desert regions, with special reference to the Sahara, the northern border of which he had recently visited. He pointed out that the arid regions of the world are distributed in two bands, north and south of the equator. They are all inland drainage areas, or areas where the streams have no connection with the sea. They are also regions where evaporation is in excess of precipitation, for if the latter were in excess the water would rise till it could flow into the sea, as in the case of the great lake district of North America, and the area would no longer be one of inland drainage. The largest of the deserts, the Sahara, is about three and a half million square miles in area, and the area of all the deserts of the world together is about 11,500,000 square miles. That is to say, over one-fifth of the land of the world has no outlet for drainage to the sea, and in all that area evaporation is greater than precipitation. These areas correspond very closely with the regions of the world where the rainfall is less than ten inches annually. In no place in the world can there be got such enormous changes of temperature as in the deserts. In the Sahara the temperature sometimes falls from 100° during the day to the freezing point during the night. This arises from the great dryness of the atmosphere, and from the radiation that takes

place from the burning soil after the sun has set. These inland drainage areas correspond very much in their barometric phenomena. In all desert regions during summer all winds blow in to them. In winter the reverse takes place, the winds flow out of them; and that holds good both for the northern and the southern hemispheres. This leads to the low rainfall, for the great majority of these regions are more or less bounded by high hills. The winds come into the deserts over these hills, and the vapor is precipitated from the atmosphere by the hills, with the result that when the winds reach the interior regions there is nothing left to be deposited. If there are not hills all round any desert area, then, as in the case of Northern Asia, the winds pass from a colder to a warmer climate, and as they get to warmer regions they are able to contain more vapor, and none is precipitated.

Dr. Murray then proceeded to give an account of his own views and impressions as to the Sahara. During the "Challenger" expedition he and his companions had found in the bed of the Atlantic for a long distance west of the African coast opposite the Sahara, and in the bed of the Indian Ocean to the south of Australia, small grains of red quartz sand; and they had found scarcely a trace of such in the sea-bed in any other part of the world. He suspected this quartz sand had been blown out from the Sahara in the one case, and from the Australian desert in the other. On his journey southward through Algeria, he found the country as far as Tougourt converted into a garden by means of artesian wells. At Tougourt the real sandy part of the desert began, and he made excursions into it, with that town as his headquarters. He exhibited to the meeting a specimen of the sand, of a light yellowish-brown color, and exceedingly fine in the grains. There were, he said, a good many clay particles in it, and the quartz particles, which were also numerous, were identical with those they had got in the bottom of the Atlantic. There was no doubt that the winds from the desert carried the sand a long way out to sea.

He had also examined the region geologically, and found that the formation of the rocks was entirely that of fresh water, and of quaternary date. The great majority of geographers and geologists have expressed the belief that the whole of the Sahara is an old sea-bed, but in his opinion, it has never as a whole been covered by the sea since Cretaceous or Devonian times; and no part of it has been covered by the ocean since Tertiary times. The whole question about the discovery of shells seems to rest upon one common species being found very rarely in one region of the desert. Owing to recent researches, the opinion as to the Sahara being an old sea bottom is very likely to disappear from our textbooks. He considers that the features of the region have been produced by atmospheric conditions. The sand is the product of the disintegration of the rocks *in situ*. The existing rock is not far below the surface, and by digging down to it, the hard sandy particles are found embedded in the stone. The sun shone on the rocks, and they expanded. The sudden cooling at night broke them up, the wind carried away the smaller particles, and so continually the rocks are being disintegrated by means of changes other than water, although water perhaps in times past played a greater rôle there than it does now. There is a range of hills in the desert, seven thousand feet high, and for three months in the year their summits are covered with snow. Descending the hills are old river-courses, some of great length. Much of the region, he considers, has once been a large fresh-water lake. Speaking of the commercial aspect of the Sahara, he said it was difficult to go there without becoming enthusiastic about it. There seems to be no limit to the amount of water that is to be got by sinking artesian wells. The cultivation of palms is extending to an enormous extent, and the French expect to carry on their railway to Tougourt, at present nearly a week's journey from Algeria, in the next few years.

BULLETIN No. 7, July, 1890, just received from the Virginia Agricultural Experiment Station, treats of tests with varieties of strawberries made the present season, giving full discussion, with critical descriptive notes of forty-nine varieties; also full tabular statements showing yields, earliness, quality, etc.

HEALTH MATTERS.

Sea Air for Phthisis.

In reviewing a recent work by Dr. Remondino, president of the Board of Health of San Diego, Cal., *The Lancet* says: "Dr. Remondino discusses at considerable length the influence of marine climates upon phthisis, and sums up strongly in their favor. This is a return to the views of Laennec and most of the older authorities—a doctrine thrown somewhat undeservedly into the shade by the good results obtained at some of the high altitude sanatoria. In forming a rational creed upon this difficult question, we must beware of the fallacy that lurks under most sweeping generalizations, and we must never shut our eyes to any well-authenticated facts. The good results obtained at Davos, Görsersdorf, Denver, Bogota, and such like elevated sanatoria, must not make us rush to the fallacious generalization that high altitudes are a specific for phthisis, nor should such facts cause us to ignore for a moment the excellent effects that often attend a sea voyage or a residence at a marine sanatorium. We have to recognize that good results may attend either method, that general rules lead only to confusion, and that our business is not to exalt the high altitudes over the sea voyage and the marine resort, or *vice versa*, but to seek as patiently as possible to determine the indications and the contra-indications for and against each type of climatic treatment. Dr. Remondino is emphatic in his opinion that atmospheric moisture, as compared with soil moisture, has no influence in generating phthisis, a view in which we quite concur.

"As regards the results of the treatment of phthisis at San Diego, Dr. Remondino speaks very confidently. He informs us that the banks, stores, and business houses are largely manned by cured consumptives; and that of the physicians, dentists, lawyers, and clergymen, it is safe to say that eight out of ten resorted to California for their health. Of 258 deaths registered from phthisis during ten years at San Diego only nine cases were born in California. In estimating the value of this fact we must remember that we are dealing with a new country, mainly peopled by immigrants. Dr. Remondino thinks cases of hemoptysis do very well in California; he has also seen apparently wonderful results in laryngeal phthisis, in which affection his experience would appear unusually fortunate.

"If past experience warns us that roseate accounts of new sanatoria must be received with much reserve, there seems every reason to admit that southern California is one of the most favored regions of the world, that its climate possesses a conjunction of advantages rarely to be found, and that the country presents many attractions for the tourist, settler, or invalid."

Death from Tight Lacing.

Happily the practice of tight lacing, though still a fruitful source of illness, does not now occupy a foremost place among the recognized causes of death. The fact that it does occasionally stand in this position, however, should be noted by those foolish persons whose false taste and vanity have made them the suffering devotees of a custom so injurious. It should be remembered also, that, whatever may be said of the more evident effects, the indirect consequences of thus tightly girding the body can not be exactly estimated. They can not be but hurtful. The veriest novice in anatomy understands how by this process almost every important organ is subjected to cramping pressure, its functions interfered with, and its relations to other structures so altered as to render it, even if it were itself competent, a positive source of danger to them. Chief among the disorders thus induced are those which concern the circulation, and it is to the laboring incapacity of a heart thus imprisoned and impeded, both as regards the outflow and return of blood, that such disastrous consequences as occurred not long ago in a Berlin theatre must be attributed. According to *The Lancet*, one of the actresses, who had taken part in an evening performance, and then seemed to be perfectly well, was found next morning dead in bed. Subsequent examination of the body showed that death was due to syncope, and this was attributed to tight lacing, which the deceased had practised in an extreme degree. As regards the persons immediately affected, the warning conveyed by this incident is obvious.

Restriction and Prevention of Diphtheria.

In a recent communication to the Health Officer of Detroit, concerning disinfection by the fumes of burning sulphur, the secretary of the Michigan State Board of Health calls attention to some important facts bearing on the subject. Excluding Detroit and Grand Rapids (the data from which cannot be profitably included with the data from the smaller places), the official reports prove, beyond a reasonable doubt, that isolation and disinfection do restrict diphtheria. In those outbreaks in which isolation and disinfection were neglected, there were on the average over fourteen cases, with nearly three deaths, to an outbreak; while in those in which isolation and disinfection were enforced, there was an average of only a little over two cases, with only about six-tenths of one death, to each outbreak. It must be remembered that these figures relate to instances in which at least one case of diphtheria had already occurred in the community, and that occasionally several cases occur at once, on the start. The method of disinfection referred to is that recommended by the State Board; namely, burning three pounds of sulphur for every thousand cubic feet of air space in a room, infected articles being loosely spread out; and, because of movement of infected articles from the sick-room and from one room to another, all rooms in the house are disinfected, together with all contents. Experiments by Pasteur and M. Roux, with the co-operation of Dujardin-Beaumetz, prove two important points in this connection: (1) that the burning of two pounds of sulphur per thousand cubic feet of air-space is not always certainly effective, and (2) that three pounds is effective. This applies to a closed room; if there are openings through which the fumes may pass, more sulphur is required.

Disappearance of Small-pox in Germany.

Under the law of Germany making vaccination compulsory and providing for re-vaccination at stated periods of life, says the *Sanitary Inspector*, small pox is almost completely disappearing from the German Empire. A late official report states that in 1888 only 110 deaths from small-pox occurred in the whole empire, and that this number is 58 fewer than occurred in 1887, and 87 fewer than in 1886. Of the 110 deaths, 88, or about four fifths of the whole number, occurred in those parts of the empire immediately bordering other countries not well protected by vaccination, and in which there is constant intercourse between the vaccinated and the unvaccinated sides of the boundary. More than one-third of all the deaths occurred in the Prussian province of Posen. Comparing the small-pox death-rate of the large cities of other countries with that of the larger cities of Germany, it was 136 times as great in the cities of Austria, 30 times as great in those of Hungary, 16 times as great in those of England, 24 times as great in those of Belgium, and twice as great in those of Switzerland, as in the German cities.

Treatment of Snake-Bites.

In a paper in the *Revue Scientifique* describing his recent researches and experiments regarding the bites of poisonous snakes, Professor Kaufmann advises that in the treatment of a bite the injured limb should be tightly bound above the bite as quickly as possible, with a handkerchief or any other available constrictor, and that then a 1-to-2 solution of chromic acid should be injected deep into the wound, making several similar injections in the neighborhood of the wound. If these directions are carefully followed, the poison will be destroyed before being absorbed. If there is already much swelling of the wound, more injections should be made in various parts of the swelling, which should then be manipulated to bring the acid thoroughly into contact with the poison. The swelling should then be freely lanced and as much as possible of the fluid squeezed out. The skin should be washed with the chromic acid solution, followed by the application of compresses saturated with the solution. If the swelling returns, these procedures should be repeated. This local treatment should be supplemented by the internal administration of alcoholic stimulants and aqua ammonia. Professor Kaufmann, however, strongly condemns the use of large quantities of alcohol, which, he thinks, paralyze and depress the nervous system.

Surgeon Parke on Vaccination.

At the great banquet of welcome given in London to Surgeon Parke, he briefly referred to the inestimable benefit of vaccination. Before the expedition started for Africa, says the *Medical News*, he vaccinated nearly every man in Stanley's little army, with the result that when they were surrounded by small-pox there were only four cases among the members of the expedition, none of which proved fatal. But among the camp-followers and irregulars, who had not been vaccinated, small-pox was almost universal, and large numbers of them died. It is probable that without the precaution of vaccination the expedition would never have had strength to complete the march across Africa.

LETTERS TO THE EDITOR.

. Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Wind-Systems.

THE remarks on the general wind-systems of the globe on page 80 of *Science* for Aug. 8 are interesting. I have been securing from various mathematicians and meteorologists numerical statements of the deflective force of the earth's rotation on moving bodies on its surface. No two such statements thus far secured agree with each other or correspond with the deflection of air-currents actually depicted on the weather maps. As I understand the communication above mentioned, there is substantial agreement on the basis of the reasonings there presented that there is neither eastward nor westward movement of the atmosphere at latitude $35^{\circ} 16'$. It is true that the south Atlantic anti-cyclone is located at nearly this latitude, and is quite persistent. But the other anti-cyclones of the northern hemisphere, with reference to which alone we have full information, are not located at this latitude. On the contrary, they form a belt, not about the geographical pole, but about a point situated twenty degrees from it at longitude 96° west. In consequence of this displacement the centre of this belt is found as far north as 55° in the eastern hemisphere. Moreover, the separate anti-cyclones constituting it have a decided tendency to move eastward. Even the south Atlantic anti-cyclone pushes eastward not unfrequently at all seasons, and either fragments are detached from it or it moves bodily across Europe. At certain seasons this easterly movement of anti-cyclones is rapid, and at times appears to be independent of surrounding cyclones. This would seem to be a feature of the circulation of the atmosphere that is not consistent with the assumption that there is absence of eastward or westward movement at latitude $35^{\circ} 16'$.

M. A. VEEDER.

Lyons, N.Y., Aug. 13.

On the Lack of the Distance-Sense in Prairie-Dogs.

SEVERAL individuals of various ages under observation at Cornell University walked off chairs, tables, and window-sills with nearly equal absence of hesitation. This deficiency of a faculty which is so conspicuous with squirrels and some other rodents may be ascribed to the nature of their usual habitat, a plain, in which the only sharp inequalities may be the burrows and mounds of their own making.

One adult female, however, has manifested an immunity from the ill effects of falls which is not easily accounted for, and may be worthy of record. When about three years old it fell down a shaft upon the wooden top of an elevator 6.6 metres (21.6 feet) below. For a few minutes it remained nearly motionless, as if stunned, but gradually revived and completely recovered. On the 14th of July, 1890, at the age of $7\frac{1}{2}$ it fell an equal distance from a window-sill upon a broad granite step. On looking out, it could not be seen; closer inspection revealed a single spot of blood, and, at the foot of the steps, a hole into which, presumably, it had crept, and from which, four days later, it was coaxed, a little wild but apparently uninjured. These two survivals are notable in

view of the peculiarly solid and "chunky" form of the animal, and the improbability that such accidents should occur in a wild state. By allowing it to fall into water or upon soft material it is intended to observe the attitude during descent. The sense of distance may be cultivated. The brains of prairie-dogs will be compared with those of squirrels.

The subject of this note is 30 centimetres (12 inches) long, the tail contributing 6 centimetres; it is fat, and weighs 755 grams (26.6 ounces); the writer does not know the ordinary size and weight. It is friendly to all, but recognizes familiar voices and hands; is practically omnivorous, drinks milk, and has killed and devoured a ruffed grouse. Like all of the species, to a sudden sound, the fall of an object, a rap on the door, the voice, a cough, and particularly a sneeze, it responds by erecting the body and barking. The nervous mechanism involved seems to be largely reflex, rapidly exhausted, but nearly or quite uncontrollable; indeed, there is reason to believe that the second fall was due to an unguarded erection of the body at the edge of the window-sill; the bark was heard at the striking of a large clock in the same tower, and when the occupant of the room turned the dog had disappeared. Do any other animals display this reflex responsiveness to sounds?

As a slight contribution to the mechanism of dreams it may be added that the second fall and disappearance occurred during the writer's absence; that he is much attached to the prairie-dog, and promptly sent directions to search for it, urging that the steps should be removed if necessary; and that the following night he dreamed of superintending the demolition of McGraw Hall; finally that neither to him nor to any others connected with the university did their appear any incongruity in the destruction of a fifty-thousand-dollar stone building for the recovery of a prairie-dog.

BURT G. WILDER, M.D.

Ithaca, N.Y., Aug. 16.

Ballooning of Spiders.

MCCOOK's great work on "American Spiders," whilst properly rejecting some proposed explanations of their aeronautics, does not offer any better explanation, but merely speaks of ascending air-currents, and gives important observations which show that the point of departure is an exposed rail fence or other elevated place in sunshine. I would suggest that the explanation is to be found in the fact that sunshine on such departure-platforms causes an upward current by heating and rarifying the air, and so starts the flight; and when (often after several vain attempts) the gossamer-line is at length sent aloft, the sunshine on the line itself will warm and rarify the surrounding lamina of air, and so increase the ascending current as to carry upwards both the filament and the suspended spider. For this last point I am indebted to Professor C. S. Young.

If these suggestions be good, then the interesting aeronautics may be expected to occur only during sunshine, and the term "ballooning" will not be entirely metaphorical, save in the sense that the rarified gas is outside instead of inside the silk mechanism.

F. MACLOSKEY.

Princeton College, N.J., Aug. 18.

AMONG THE PUBLISHERS.

THE index for the September number of the *Chautauquan* shows the following inviting subjects: "On the Nature and Value of Folk Lore," by L. J. Vance; "Sacred Trees," by Dr. Ferd. Adalb. Junker von Langegg; "The Supreme Court of the United States," by Eugene L. Didier; "Experiment Stations: What is an Investigation?" by Byron D. Halsted, Sc.D.; and "Modern Magic and its Explanation," by Marcus Benjamin, Ph.D.

—E. & F. N. Spon announce a treatise on "Water Supply, Drainage, and Sanitary Appliances of Residences," including lifting machinery, and lighting and cooking apparatus, by Frederick Colyer; "Sewage Disposal," being fourteen years' experience in works of intermittent downward filtration, separately and in combination with surface irrigation, with notes on the practice and results of sewage farming, by J. Bailey Denton (second edi-

tion, with additions); and "Drainage with Regard to Health, and Modes of Disposal of Town Sewage," by George J. C. Broom, F.G.S.

—Messrs. D. Appleton & Co. announce that the third volume of McMaster's "History of the People of the United States" is now well advanced, and will be published probably in the course of the winter. It will be remembered that the second volume closes with the negotiations regarding the Louisiana purchase. In the new volume, which will contain eight chapters, Professor McMaster begins with the debate in the House regarding the constitutionality of the Louisiana purchase, and he closes the volume with a discussion of the political and economic effects of the War of 1812.

—Ginn & Co., publishers, announce as in preparation "Allen and Greenough's Ovid," revised edition, edited by Harold N. Fowler, Ph.D., instructor in Latin in Phillips Exeter Academy; with a vocabulary by James B. Greenough, professor of Latin in Harvard University, which is intended to be of the same character as vocabularies to Virgil, Cæsar, etc., by the same author. The editor believes that the poems of Ovid are, as regards both style and subject matter, better adapted than those of Virgil to serve as an introduction to the study of Latin poetry. He therefore intends to furnish the book with copious notes suited to the needs of young students, which will be supplemented by grammar references and an introduction on the life and works of Ovid and on mythology. The selections are taken mainly from the "Metamorphoses," and are chosen with a view to making the study of Latin interesting. The value of the book will be greatly enhanced by the addition of the vocabulary.

—Among the books in press announced by the J. B. Lippincott Company are "The Distribution of Wealth," by Rufus Cope; "Hermetic Philosophy," by J. S. McDonald, author of "Vital Philosophy," etc.; "The German Soldier in the Wars of the United States," by J. G. Rosengarten (second edition, revised and enlarged); "Regional Anatomy in its Relation to Medicine and Surgery," by George McClellan, M.D., illustrated from photographs taken by the author of his own dissections, expressly designed and prepared for this work, and colored by him after nature (this last-named work is to be sold by subscription only); and "Historic Note-Book," by the Rev. E. Cobham Brewer, LL.D., Trinity College, Cambridge, author of "The Reader's Hand-Book," "Dictionary of Phrase and Fable," etc.

—In the early summer of 1889 a circular-letter was issued to the working entomologists of the country, offering prizes for essays containing original investigations regarding methods of destroying the mosquito and the house-fly. The object of this effort was to bring about an intelligent discussion of the question, What natural enemies of these irritating insects may be easily and efficiently arrayed against them? The voracious and harmless dragon-fly, of which our country supplies so many beautiful varieties, was especially designated as possessing qualities that made it a promising subject for careful investigation. The plan of destruction thus sought for is that so commonly observed in operation upon a grand scale in nature, where individual species and whole families are swept out of existence through its operation. The questions formulated in the circular-letter were widely discussed. Newspapers and other periodicals treated them from a hundred standpoints; a volume could be filled with articles relating to the subject published in this country and in Europe. The most valuable results were, as expected, those submitted by the scientific experts especially appealed to. The essays that they presented are the outgrowth of long years spent in rearing insects, studying their transformations and habits, and of extensive special reading. These essays were found so full of valuable scientific and popular information that the recommendation of the distinguished judges acting under the terms of the circular letter, to place them in a printed form before the public, has been complied with in the volume "Dragon-Flies versus Mosquitoes," published by D. Appleton & Company. An article contributed by Dr. McCook to the *North American Review* is reproduced with especial view to his observations on mosquito-catching spiders. Captain Macauley, of the United States Army, furnishes an interesting chapter of his experience among the

dragon-flies and mosquitoes of the upper Missouri. The book is illustrated with colored and other plates.

—Among other articles, the *Westminster Review* for August contains the following: "Mr. Stanley's New Book;" "Lunacy Law Reform;" "Life in Achill and Aran," by Michael MacDonagh; "Cremation at Milan," by H. Sutherland Edwards; "Divorce: Does Scripture Forbid It?" by A. P. Richards; and "The New Educational Code: Will it Work?" by Joseph J. Davies. The *Scottish Review* for the same month contains "Canada and the United States," by J. G. Bourinot; "Traces of a Non-Aryan Element in the Celtic Family," by Professor J. Rhys; "Bikelas on Scotland," by J. S. Blackie; "The Interpretation of the Critical Philosophy;" "Oriental Myths and Christian Parallels," by Florence Layard; "Odd Foods," by Alfred J. H. Crespi; "The Cession of Heligoland," by Andrew T. Sibbald. In the *Nineteenth Century* for August are to be found "The Value of Africa: a Reply to Sir John Pope Hennessy," by H. H. Johnston; "On the Rim of the Desert," by E. N. Buxton; "The Power of Suggestion," by A. B. McHardy; "Primitive Natural History," by Geo. J. Romanes; "The American Silver Bubble," by Robert Giffen. The *Contemporary Review* this month has an illustrated article on "Christ among the Doctors," and an article on "Women and the Universities." Other articles are "How British Colonies Got Responsible Government," by Sir C. G. Duffy; "The National Home Reading Union and its Prospects," by J. C. Collins; "The Shetland Isles in the Birds'-Nesting Season," by T. Digby Pigett; "Illustrated Journalism," by Carmichael Thomas; "The Prehistoric Races of Italy," by Canon Isaac Taylor; "The Nihilisms and Socialisms of the World," by J. Page Hopps; "The Organization of Unskilled Labor," by R. Spence Watson; "A Defence of University Lectures," by Professor William Knight; and "Britain Fin de Siegle," by Frederick Greenwood. The *Fortnightly* has articles on "The Latest Discoveries in Hypnotism," by Dr. J. Luys; "The Stronghold of the Sphakiotes," by James D. Bouchier; "Ethics and Politics," by Sir Rowland Blennerhassett; "Labor Disputes in America," by Dr. W. H. S. Aubrey; "The Educational Outlook," by the Rev. J. R. Diggie; "Armenia and the Armenian People," by E. B. Lanin; and "War in the Future," by Col. W. W. Knollys.

—Bulletin No. 22 of the United States Department of Agriculture comprises the reports of the field agents of the Division of Entomology which were necessarily omitted from the annual report. Although Mr. Coquillett has reported upon several phases of his work, the Bulletin gives only the portion relating to the experiments which he made in the destruction of the red scale of California (*Aspidiotus aurantii* Maskell) by the use of washes. A portion of his report relating to experiments with gas treatment for this scale insect, resulting in the great cheapening of the use of this process, was printed in *Insect Life* for January and February, 1890. Another section of his report, relating to the attempted colonization of the insects preying upon *Icerya purchasi*, imported by Mr. Koebele from Australia, was published in part in *Insect Life* for October, 1889, and the remainder is reserved for future use. The experiments with washes were undertaken with a view of presenting a practical illustration of their utility to the fruit-growers of southern California, who had apparently ignored the previous results obtained and published in the reports for 1886 and 1887. The red scale was particularly chosen on account of its importance as a pest, and for the further reason that the fluted scale seems at present to require no further experimentation, since the vedalia is overcoming it so rapidly. Professor Osborn, we learn from the Bulletin, has taken up the study of insects injurious to grasses, in addition to his regular work upon the insect parasites of domestic animals, and reports upon the leaf-hoppers injuring forage plants. This is a comparatively new and important field of investigation. Professor Webster continues his studies of grain insects, and reports upon certain points connected with the economy of a few well-known pests. Miss Murtfeldt sends in a general report upon the insects of the season in eastern Missouri, brings out a number of interesting facts, and gives the life history of a beetle injuring spinach, and also the histories of two interesting saw-flies. Mr. Koebele during the

latter part of the season did considerable field work, and reports upon a number of injurious species. Perhaps the most interesting feature of his report is his work upon the enemies of the codling moth in California. He has reared four entirely new parasites of this species, two of which are primary and two secondary. The egg parasite seems to be a very important feature in the life of the codling moth on the Pacific coast, and we know from previous experience with egg-parasites of the same genus that they are capable of very rapid development, and are consequently very beneficial insects where they attack injurious species. Professor Bruner treats of the insects of the year, and enters upon the consideration of insects detrimental to the growth of young trees on tree claims in Nebraska and other portions of the West, an important subject which has not before received treatment.

—No. 12 of Blakiston's (Philadelphia) series of "Quiz-Compend" has just been published. These compends are based on popular text-books and the lectures of prominent professors, and are kept constantly revised, so that they represent the present state of the subjects upon which they treat. The one now before us, No. 12, "A Compend of Equine Anatomy and Physiology," by Professor William R. Ballou, supplies for students of veterinary anatomy and physiology a work which will answer their needs not only as a text-book, but also for work in the dissecting-room. In its preparation the standard work of Chauveau has been followed in the main, though the works of Strangeways, Gray, and Quain have also been consulted. The work is illustrated with twenty-nine engravings, selected for the purpose from Chauveau's "Comparative Anatomy."

—Bulletin No. 24, from the Agricultural Experiment Station, Madison, Wis., is entitled "A New Method for the Estimation of Fat in Milk, Especially Adapted to Creameries and Cheese Factories." Dr. S. M. Babcock, chemist of the station, has devised a method for determining the amount of fat in milk, which appears to be simple, economical, and accurate. Briefly described the method is as follows. A carefully measured sample of milk is

placed in a test bottle having a long narrow neck. Next, an equal volume of sulphuric acid is added, and the bottle is placed in a wheel, which is revolved horizontally from six hundred to eight hundred times per minute, for about six minutes. At the end of this time the fat of the milk set free by the acid has risen to the top of the liquid. Hot water is then poured into the bottle, partly filling the neck. Upon again whirling for a couple of minutes the fat will rise through the water into the neck, in a long column, where it is easily read off by graduations on the neck. By this method the fat in skim milk, buttermilk, whey, cream, and even cheese can be determined.

—Messrs. Ginn & Co. have published "The Nine Worlds," by Mary E. Litchfield, being stories from the Norse mythology. The stories are based upon the Eddas, but the authoress has also relied much upon the best German and other authorities. Unfortunately, she has, as she admits in her preface, drawn largely upon her own imagination, the first story in the book having no foundation except a few lines of poetry, which really do not support it at all. Hence, though she tells us much about the mythology of the Norsemen, her book cannot be relied upon as an authority. The leading character in most of the myths is Loki, the spirit of evil, while Odin, Thor, and various other gods and giants, are brought prominently forward. The slaying of Baldur, who represents the summer sun, and the carrying off of Iduna, the goddess of spring, are among the most interesting myths. Miss Litchfield gives in an introduction an account of the Norse cosmology, and in an appendix a glossary of the names and attributes of the various gods and other personages. The book will interest those who like tales of the marvellous, and will impart some general information about the Norse mythology.

—The "Summary of the Seventh Annual Report of the Bureau of Statistics of Labor of the State of New York" contains matter of interest to economists. It is devoted to an account of the various strikes, lock-outs, and boycotts that have occurred in the State during the past five years, with statistical tables showing the

Publications received at Editor's Office,
July 21-Aug. 9.

- AMERICAN Association for the Advancement of Science, Proceedings of, Thirty-eighth Meeting, August, 1889. Salem, Permanent Secretary. 496 p. 8c.
- ANNUAL Report of the Chief Signal Officer of the Army to the Secretary of War, for the year 1889. Parts I and II. Washington, Government. 389 + 165 p. 8c.
- ANNUAL Report of the Department of Mines of New South Wales, 1889. Sydney, Government. 253 p. 1c.
- BUNYAN, John. Pilgrim's Progress. (Classics for Children.) Ed. by D. H. Montgomery. Boston, Ginn. 119 p. 12c. 35 cents.
- HARDY, A. S. Elements of the Differential and Integral Calculus. Boston, Ginn. 239 p. 8c. \$1.65.
- INTERNATIONAL Marine Conference, 1889, Proceedings of. Vols. I, II, and III. Washington, Government. 814 + 680 + 502 p. 8c.
- MIAMI Horticulturist. Vol. 1. No. 1. m. Bradford, Ohio, M. Cassel. 8 p. 4c. 25 cents per year.
- MONTGOMERY, D. H. Leading Facts of American History. Boston, Ginn. 412 p. 12c. \$1.10.
- MULLER, F. Max. Three Lectures on the Science of Language. Chicago, Open Court Publ. Co. 112 p. 8c. 75 cents.

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causes and results of the strikes and the costs to both parties. In giving the number of strikes, each establishment is reckoned separately, so that if a general strike occurred affecting a hundred establishments it counts in the report as a hundred strikes. On this basis it appears that during the five years from 1885 to 1889 the number of strikes in the State was 9,334, of which 5,866 were successful and 3,468 unsuccessful, while 50 were pending at the time of making up the report. The loss to the laborers is set down at over \$3,000,000, and the gain in wages for five years at upwards of \$18,000,000. Commissioner Peck thinks that there is no likelihood of a discontinuance of strikes, and believes that on

the whole they are beneficial to the laborers. He shows, however, that there is a strong disposition on the part of most labor organizations to exhaust all peaceful means of settling difficulties before striking, and quotes largely to this effect from their rules and regulations. The feeling of many employers about labor disputes is well expressed in a remark by one of their number which is quoted in the report: "When they have us down they give it to us; and when we have them down we give it to them" (p. 51). The commissioner believes, however, that "large-souled employers have no hard feelings against employees who protect themselves in an open and honorable manner."

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Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the "Want" inserted under this head FREE OF COST, if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.

TO PRINCIPALS OR COMMITTEES.—Professor of Classics and Sciences, experienced in advertising and building up schools, now employed, desires change. WILLIAM, Roslyn, L. I.

WANTED.—A graduate from the Advanced Course of the Framingham State Normal School desires an assistant's position in a high school. An appointment in New England preferred. Address G., Lock Box 4, Framingham, Mass.

HYBRIDS.—A. M. Suchetet, 10 Rue Alain, Rouen, France, desires to correspond with those possessing hybrids, either living specimens or stuffed, of mammals, birds or other animals.

WANTED.—A Mining Engineer of standing and experience. One having had practical experience in Coal Mining and the manufacture of Coke preferred. Address A., care "SCIENCE."

CHEMIST.—A Harvard Graduate and Specialist in Chemistry desires a position with some manufacturing industry, or with a practical chemist. He would make an engagement to take charge of a laboratory and lecture on Chemistry. He has had large experience in the laboratory and school-room, and can give the best of references. Address J., Harvard College, Cambridge, Mass.

WANTED.—A Lady Teacher, at present teaching in England, with 12 years of very successful experience in primary work, desires a similar position in America. An appointment in the State of Ohio, or the City of New York, preferred. Excellent references, etc. Address in July or August, L. DUNCAN, Poste Restante, Stainland, Halifax, England.

WANTED.—The latest and most reliable authorities on the Occurrence, Analysis, and Practical Uses of Native Hydro-Carbons, such as Bitumen, Asphaltum, Mineral Wax, etc. Address DR. J. E. TALMAGE, Box 1,047, Salt Lake City, Utah.

A ZOOLOGIST, acquainted with the United States, graduate (Ph.D. Freiburg, B.Sc. of an English university) of many years' standing; late Fellow of an English college; late assistant to a German university, professor of Comp. Anatomy; many years a student at two German universities; pupil of Huxley, Kölliker, Semper, Wiedersheim and Weismann; author of many well-known memoirs on Comp. Anatomy and Embryology; thoroughly conversant with all branches of the subject; fond of teaching, with good testimonials, seeks a Professorship. Address "MORPHOLOGIST," Office of SCIENCE. Other information and a few testimonials can be seen at the Office of SCIENCE.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Riley's Missouri Reports, either singly or full set, for Proceedings Entomological Society, Philadelphia, vols. 2 to 6 inclusive. Will also exchange Casey's Revision of the *Stenini* of N. A. and Horn's Revision of the *Tenebrionidae*. F. M. Webster, La Fayette, Ind.

I wish to exchange a fresh and complete set of Weiss and Spier's "Necropolis of Ancon" for other books, either new or second-hand, if the latter are in good condition. What have you to offer? Address Warren Watson, Kansas City, Mo.

1,000 botanical specimens representing 250 genera in exchange for those not in my collection. Send list of duplicates, and receive a similar one to choose from. Address E. E. Bogue, Orwell, Ashta Co., Ohio.

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted.—To furnish roots of *Dodecatheon meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.